A REVIEW OF AERONAUTICS R&D AT FAA AND NASA

Prepared by the House Science Committee

Major Issues In Aeronautics

Decline in aeronautics research and development spending in the face of looming industry challenges. Between FY1998 and FY2003, NASA cut aeronautics research by half. Even though the FY2004 NASA budget request reflects a 1 percent increase in aeronautics technology funding compared to FY2003, over the next five years, funding will be reduced by 4 percent (without accounting for inflation). FAA funding has also been reduced. The FY2004 request is $279.0 million, about a five percent reduction from the previous year.

U.S. aerospace industries are highly reliant on technologies enabled by NASA – and to a lesser extent by FAA – research. Aerospace business markets today make it difficult for companies to invest huge sums in high-risk, long-term R&D activities. The consequences of insufficient research and development investment are already being felt in several ways. Key issues include the following:

- **Aviation Gridlock.** Beginning in the late 1990s, and especially during the summer of 2000, our nation's air traffic control infrastructure was unable to accommodate growth in traffic demand. As a result, commercial air carriers routinely suffered from system delays caused by congestion along busy airway corridors and lack of capacity at many of the larger hub airports to land or takeoff. Traffic declined following the September 2001 terror attacks, but is expected to resume an annual growth rate of 3.8 percent.

- **Eroding U.S. Share in International Aerospace Markets.** Our country's sole domestic producer of large civil aircraft (Boeing) faces fierce competition from the European manufacturer, Airbus, for sales of large civil aircraft. For the first time ever, Airbus won 50 percent of new aircraft orders during 2002.

- **Elimination of Rotorcraft R&D.** Rotorcraft continue to serve many important civil and military markets here and abroad, yet much research remains to be done to make them quieter, more robust, and more efficient. In FY2003, NASA proposed elimination of rotorcraft research and did so again in the FY2004.

- **Noise and Emissions Reduction.** The future success of commercial civil aerospace products will rely heavily on developing quieter and less polluting aircraft. International standards setting organizations, and particularly some European countries, are proposing noise and emissions reductions requirements to meet environmental concerns. NASA proposes augmenting its Quiet Aircraft Technology program in the FY2004 budget to meet this challenge. The goal is to accelerate the development and transfer of technologies to reduce perceived noise by half by 2007 compared to a 1997 baseline.

FAA's Research and Development Funding Structure. FAA's R&D is principally funded through its Research, Engineering and Development (R,E&D) account. Over the last several years, however, FAA has migrated a number of R,E&D activities into other operational accounts, making it difficult to get clear insight into FAA's aeronautics research and development programs.

FAA/NASA Collaborations – Joint Program Office. FAA and NASA are increasingly collaborating on research and development for next-generation airspace management and vehicle systems technologies. They are in the formative stages of creating a Joint Program Office (JPO)[1] to design and develop technologies to enhance capacity, safety, and efficiency of our National Airspace System. While the creation of the JPO is a clear sign that these issues are receiving greater attention, the cultures and missions of FAA and NASA are very different, so it will require significant and sustained commitment from all involved for it to succeed. Specifically, FAA is an operational agency primarily focused on safely and efficiently directing aircraft. In contrast, NASA is a research and development agency that – with respect to aeronautics – is not burdened by the same urgency confronting FAA to constantly maintain safe operations. NASA scientists and engineers perform remarkable research, but it may take them years to develop an operationally suitable technology for FAA to evaluate. Bridging these two divides has – in the past – proven difficult.

Effects of Full Cost Accounting at NASA. For the first time, NASA submitted its budget in full cost accounting. This means that all direct and indirect costs, such as institutional support, are in the same budget line, giving the appearance that its aeronautics budget nearly doubled over last year. NASA's aeronautics program is actually increased by only $10 million or 1 percent, and is projected to shrink by 4 percent over the next five years. While full cost accounting may reflect the true cost of programs, concerns have been raised that implementation of full cost accounting for NASA-owned facilities such as wind-tunnels and engine test stands may result in much higher rental fees to outside researchers. If costs are too high, researchers may choose to use wind-tunnels in other countries, jeopardizing the security of their research findings.

Background

Since the late 1940's, aerospace has been a major source of high paying jobs that has created and sustained a variety of other high technologies. Aerospace is the largest source of exports (measured by dollars) for the United States. Over the last two decades market forces, international competition, and industry consolidations have reduced the number of domestic large civil airframe manufacturers[2] to just one: the Boeing Company. The number of domestic manufacturers of turbine powerplants has been reduced to two: (Pratt and

[1] FAA and NASA have invited DOD, DOT, the Department of Homeland Security, and the Dept. of Commerce to join this effort.

[2] While Boeing is the only domestic supplier of large civil aircraft, there are multiple domestic suppliers for military and general aviation aircraft.

Whitney; General Electric). There is no domestic manufacturer of regional jets, the largest growth segment in our domestic commercial aviation system today.

On November 18, 2002, the Congressionally-chartered *Commission on the Future of the United States Aerospace Industry* produced its final report.[3] The Commission raised a number of issues about the ability of domestic companies to maintain primacy in aerospace markets worldwide. Specifically, the Commission is concerned that the decline in federal aeronautics research spending, and the lack of coordination among executive and legislative entities that control investment strategy, will undermine U.S. dominance in the aerospace industry.

The Commission also cited growing efforts by foreign governments to develop aerospace capabilities through subsidization of product development and sales costs. In particular, the Commission highlighted the European Union's "Aeronautics 2020" program that seeks to coordinate the research and manufacture of European-produced aerospace products among its member states. The program also sets specific market-share targets for European-produced civil and military aerospace products in world markets, and the development of a European designed and manufactured air traffic management system.

Federal Aviation Administration Research and Development

FAA's overall mission is to provide ". . .a safe, secure, and efficient global aerospace system that contributes to national security and the promotion of U.S. aerospace safety." It achieves these goals by regulating the design, development and operation of aircraft flown in U.S. airspace, and by managing the National Airspace System (NAS) through a nationwide network of air traffic control facilities. For FY2004, FAA proposes to spend just over $14 billion to perform these missions.

FAA proposes to spend $279.0 million on research and development, about 2 percent of the agency's $14 billion budget. R&D supports three strategic goals:

- **Safety:** By 2007, reduce U.S. aviation fatal accident rates by 80 percent from 1996 levels.
- **System Efficiency:** Provide an aerospace transportation system that meets the needs of users and is efficient in the application of FAA and aerospace resources.
- **Environment:** Prevent, minimize and mitigate environmental impacts, which may represent the single greatest challenge to the continued growth and prosperity of civil aerospace.

[3] The full Science Committee has scheduled a hearing on the Commission's Final Report for Wednesday, March 12, at 2:00 pm. The Report can be found at www.aerospacecommission.gov/.

FAA funds R&D to achieve these goals in three accounts: Research, Engineering and Development; Airport Improvement Program; and the Facilities and Equipment Program.

FAA Research and Development Funding - FY04 Budget Request
($=Thousands)

Program	FY03 Request	FY04 Request	FY05 Runout	FY06 Runout	FY07 Runout	FY08 Runout	TOTAL FY04-FY08
Research & Development - TOTAL	**$295,511**	**$279,317**	**$290,392**	**$290,868**	**$301,045**	**$292,227**	**$1,453,849**
Airport Improvement Program	14,186	17,417	17,592	17,768	17,646	17,826	88,249
Facilities & Equipment Program*	154,689	161,900	170,800	168,100	176,400	164,400	841,300
Research, Engineering & Development	126,636	100,000	102,000	105,000	106,999	110,001	524,000

* FAA's Federally Funded Reseach and Development Center is included in the F&E account.

FAA's national research laboratories are located at the William J. Hughes Technical Center, Atlantic City, NJ.

National Aeronautics and Space Administration – Aeronautics R&D

NASA's Aeronautics Technology Research and Development program is funded through the Office of Aerospace Technology account. The mission of this program is to perform R&D to enable a safer, more secure, environmentally friendly and efficient air transportation system, increase the performance of military aircraft, and develop new uses for science for commercial missions. Through partnerships with the Defense Department and FAA, NASA conducts research to enhance the security of the National Airspace System. Research areas include advanced propulsion technologies, lightweight high-strength adaptable structures, adaptive controls, advanced vehicle designs, and collaborative design and development tools. As indicated earlier, NASA is collaborating with FAA in a Joint Program Office to address air traffic management technologies.

Aeronautics R&D funding has been cut by one-half since FY1998. The FY2004 budget request essentially flat-funds the program for this year and projects a 4 percent decrease over five years. As reflected in the budget table in the appendix, the Aeronautics Technology budget has three major R&D activities. They are:

- **Aviation Safety and Security:** Aviation Safety and Security is aimed at research and technologies that will improve vehicle safety, weather forecasting and display tools, system safety technologies, and aviation security technologies. Examples include developing "refuse to crash" aircraft; synthetic vision; and improving human/machine integration in design, operations, and maintenance.
- **Airspace Systems:** Airspace Systems is focused on developing system and software tools to enable major increases in the capacity and mobility of the air transportation system for operations and vehicle systems. Examples include the Small Air Transportation Systems (SATS) program to permit all-weather operations by non-commercial aircraft at untowered fields; the Virtual Airspace

and Modeling Simulation (VAMS) program to give researchers a computer-generated "virtual" environment to test new air traffic control concepts and procedures; and a new initiative for FY2004, the NASA Exploratory Technologies for the National Airspace System (NExTNAS), to conduct assessments of distributed air/ground traffic management concepts.

- **Vehicle Systems:** Vehicle Systems research focuses on developing technologies for future aircraft and air vehicles that, if implemented, will reduce NOx emission to reduce pollution near airports and in the lower atmospheric zone, reduce emissions of the greenhouse gas CO_2, and reduce aircraft noise. NASA also conducts longer-term research on technologies for next generation vehicles through this activity.

NASA - Aeronautics Technology FY04 Budget Request
($=Thousands)

Program	FY03 Request*	FY04 Request	FY05 Runout	FY06 Runout	FY07 Runout	FY08 Runout
Aeronautics Technology - TOTAL	**$949.2**	**$959.1**	**$932.2**	**$938.7**	**$933.8**	**$916.4**
Aviation Safety & Security	156.2	168.5	188.4	175.2	178.2	170.9
Vehicle Systems	604.6	573.5	585.8	591.4	571.7	569.5
Airspace Systems	188.4	217.1	158.0	172.1	183.9	176.0

*Reflects Full Cost Accounting.

New Initiatives – NASA Aeronautics:

NASA's FY2004 budget request includes three new initiatives within Aeronautics Technology. They are:

- **Aviation Security:** NASA proposes to spend $21 million for FY2004; $225 million over five years (funded through the Aviation Safety and Security Program) to help reduce the vulnerability of aviation to terrorist and criminal acts.
- **National Airspace System Transition:** NASA proposes to spend $27 million for FY2004; $100 million over five years (funded through the Airspace Systems Program) on technologies for a next-generation National Airspace System.
- **Quiet Aircraft Technology:** NASA proposes an augmentation to an existing program for quiet aircraft. NASA proposes to spend an additional $15 million in FY2004, and an additional $100 million over five years. In total, this program will receive $271.6 million over five years (funded through the Vehicle Systems Program). The goal is to accelerate development and transfer of technologies to reduce perceived noise by half by 2007 compared to a 1997 baseline.

NASA Aeronautics research is conducted primarily at the Langley Research Center (VA); Ames Research Center (CA); Dryden Flight Research Center; and the Glenn Research Center (OH).

Appendix A

FAA Research and Development Funding - FY04 Budget Request ($=Thousands)								
Program Project	FY03 Request	FY04 Request	FY05 Runout	FY06 Runout	FY07 Runout	FY08 Runout	TOTAL FY04-FY08
Research & Development - TOTAL	**$295,511**	**$279,317**	**$290,392**	**$290,868**	**$301,045**	**$292,227**	**$1,453,849**
Airport Improvement Program	**$14,186**	**$17,417**	**$17,592**	**$17,768**	**$17,646**	**$17,826**	**$88,249**
Airports Technology - Efficiency	6,586	7,750	7,828	7,906	7,985	8,065	39,534
Airports Technology - Safety	7,600	9,667	9,764	9,862	9,661	9,761	48,715
Facilities and Equipment Program	**$154,689**	**$161,900**	**$170,800**	**$168,100**	**$176,400**	**$164,400**	**$841,600**
Airspace Management Laboratory	4,600	7,000	9,000	9,500	10,200	12,000	47,700
Aviation System Capacity Improvement	5,300	6,500	8,100	8,700	9,300	10,000	42,600
Center for Advanced Aviation Systems Development	81,364	90,800	95,400	100,000	105,000	110,300	501,500
Cyber Security for NAS Development	2,625	1,700	2,700	2,000	2,000	3,000	11,400
Domestic Reduced Vertical Separation Minima (DRVSM)	2,100	1,900	*	*	*	*	1,900
Free Flight - Phase 2	7,000	0	2,200	0	0	0	2,200
General Aviation and Vertical Flight Technology	1,000	1,400	1,500	1,500	2,000	2,000	8,400
NAS Requirements Development	3,000	3,000	3,000	3,000	3,600	3,100	15,700
NAS Safety Assessments	0	1,000	&	&	&	&	1,000
Navigation - LAAS	2800	0	0	0	0	0	2,800
Navigation - WAAS	3100	0	0	0	0	0	3,100
Operations Concept Validation	2,500	2,700	5,000	5,600	6,200	8,000	27,500
Required Navigation Performance	0	2,000	*	*	*	*	2,000
Runway Incursion Reduction	6,700	8,200	8,200	9,100	6,300	4,900	36,700
Safe Flight 21 - Alaska Capstone	15,000	21,400	19,100	14,500	16,600	0	71,600
Safe Flight 21 - Ohio River Valley	11,400	6,900	10,000	6,000	5,400	0	28,300
Safer Skies	3,000	3,400	3,000	3,000	3,000	3,000	15,400
Separation Standards	2,200	2,500	2,500	3,100	3,700	5,000	16,800
Software Engineering R&D	1,000	1,500	1,100	2,100	3,100	3,100	10,900
Research, Engineering and Development	**$126,636**	**$100,000**	**$102,000**	**$105,000**	**$106,999**	**$110,001**	**$524,000**
Advanced Materials/Structural Safety	3,053	2,766	2,835	2,928	3,000	3,096	14,625
Aeromedical Research	6,606	6,362	6,659	6,959	7,266	7,592	34,858
Aging Aircraft	26,217	17,920	18,212	18,702	18,980	19,458	93,272
Air Traffic Control/Airway Facilities Human Factors	10,317	8,899	9,193	9,543	9,860	10,231	47,726
Aircraft Catastrophic Failure Prevention Research	1,920	762	786	815	841	872	4,076
Aviation Weather - Efficiency	9,099	0	0	0	0	0	0
Aviation Safety Risk Analysis	6,815	7,898	8,006	8,208	8,307	8,500	40,919
Environment and Energy	7,698	7,975	8,085	8,289	8,389	8,583	41,321
Fire Research and Safety	6,429	7,725	7,902	8,149	8,330	8,582	40,688
Flight Deck/Maintenance/System Integration Human Factors	10,411	8,394	8,588	8,859	9,058	9,333	44,232
Flight Safety/Atmospheric Hazards Research	4,430	4,595	4,694	4,837	4,938	5,082	24,146
Propulsion and Fuel Systems	5,711	1,146	1,199	1,254	1,312	1,373	6,284
Strategic Partnerships	610	0	0	0	0	0	610
System Planning and Resource Management	1,459	1,261	1,270	1,296	1,302	1,326	6,455
Weather Program - Safety	19,406	20,852	21,030	21,483	21,613	22,024	107,002
William J. Hughes Technical Center Laboratory	6,455	3,425	3,541	3,678	3,803	3,949	18,396
* Funding requests are under review							
& Program schedule under development							

Appendix B

National Aeronautics and Space Administration
Aeronautics Technology
($=Millions)

	Businesss as Usual	FULL COST					
Program	President's FY03 Request	Est. President's Req. FY03	FY04	FY05	FY06	FY07	FY08
Aeronautics Technology	**$541.4**	**$949.2**	**$959.1**	**$932.2**	**$938.7**	**$933.8**	**$916.4**
Aviation Safety & Security	**95.0**	**156.2**	**168.5**	**188.4**	**175.2**	**178.2**	**170.9**
Vehicle Safety Technologies	49.8	83.9	74.5	81.5	-	-	-
System Safety Technologies	24.3	31.6	31.1	20.7	-	-	-
Weather Safety Technologies	20.9	40.7	42.3	42.5	-	-	-
Integrated Intelligent & Intuitive Sys.	-	-	-	-	117.5	119.8	126.2
Aviation Security Technologies	-	-	20.6	43.7	57.7	58.4	44.7
Vehicle Systems	**321.3**	**604.6**	**573.5**	**585.8**	**591.4**	**571.7**	**569.5**
Quiet Aircraft Technology (QAT)	20.0	41.4	60.2	71.0	74.0	25.0	
21st Century Aircraft Technology (TCAT)	29.0	46.0	42.0	42.5	42.1	-	-
Flight Research	58.9	91.4	85.4	43.3	10.5	-	-
ERAST	[20.0]						
Advanaced Vehicle Concepts	34.7	72.5	41.0	49.7	-	-	-
Hyper-X	[27.0]						
Breakthrough Vehicle Technologies	61.9	124.2	115.3	115.9	143.1	-	-
Ultra Efficient Engine Technologies	50.0	87.8	90.0	88.1	91.0	-	-
Propulsion and Power	66.8	141.3	139.6	125.1	31.0	-	-
Clean Adaptive Vehicle Systems	-	-	-	50.2	199.7	546.7	569.5
Airspace Systems	**125.1**	**188.4**	**217.1**	**158.0**	**172.1**	**183.9**	**176.0**
Adv. Air Transportation Technology (AATT)	71.6	103.5	105.6	-	-	-	-
Small Aircraft Transportation System (SATS)	20.0	29.2	30.6	9.9	-	-	-
Virtual Airspace Modeling & Simulation (VAMS)	23.0	35.3	33.3	33.0	35.0	34.0	-
Aviation Operations Systems	10.5	20.4	20.6	19.3	12.3	-	-
NASA Exploratory Technologies - NAS (NExTNAS)	-	-	27.0	95.8	124.8	149.9	176.0